

DUAL MANIFOLD MOLD WITH ROTATING CENTER PLATE

BACKGROUND

Two-component injection molds are widely used to manufacture a variety of products. Typical of such products are screw caps for beverage cartons which have reclosable spouts consisting of a polyethylene boss and a polypropylene screw cap. The boss and cap are manufactured in a two-component, or two-shot, injection molding machine. In the first shot, the polyethylene boss is molded as a pre-form. This pre-form then is transferred to the finish injection station, where the second shot or injection of the polypropylene screw cap is made. The composite spout/screw cap then is ejected from the machine as a finished part.

In the past, the majority of two-component injection molding machines transferred the pre-form from the first to the second station for the over-molding by rotating a complete mold half (a rotary machine plate), or rotating part of the ejector-side mold half (indexing plate). In both cases, the pre-form and the finished part are on one parting line, side-by-side. A significant drawback of such a technique is that a large mold clamping area is required; and consequently, it is necessary to use large injection molding machines. Large machines are more costly than small machines, thereby increasing the cost of the finished product.

Two-component injection molding machines of the type described immediately above, while requiring relatively large machines for effecting the operation, still are reasonably practical for molding

1 relatively small parts, such as beverage carton caps of the type  
2 described above. For products which have larger dimensions,  
3 however, such as toothbrushes which are several inches long, such  
4 conventional two-component injection molds require very large  
5 injection molding machines because of the relatively long  
6 longitudinal dimensions of the toothbrush handles. Several inches  
7 are required for each set (the pre-form side and the second shot  
8 side), as opposed to only one or two inches (for each part) for  
9 beverage carton caps, or the like.

10 In an effort to reduce the size of the injection molding  
11 machine required for two-component molded parts, a mold with a  
12 rotating center plate between a fixed plate and a movable plate has  
13 been devised. This mold is particularly useful for producing the  
14 two-component beverage carton caps described above. When the mold  
15 is closed, the center plate is sandwiched or stacked between the  
16 other two plates. The pre-forms are formed between one side of the  
17 center plate and one of the other, generally conventional plates.  
18 The second shot or completion of the product then is formed between  
19 the other side of the center plate and the other one of the  
20 conventional plates. The mold then is opened; and the two-  
21 component finished products are ejected. The center plate is  
22 rotated to place the pre-form parts into position for injection of  
23 the second mold, and readying the mold for formation of the pre-  
24 forms on the side from which the finished products have been  
25 ejected. Each cycle of operation effects a 180° rotation of the  
26 center plate about its vertical center line (or a center line

1 perpendicular to the movement of the other two plates toward and  
2 away from the center plate). The utilization of the rotating  
3 center plate, onto which the other two plates are closed and  
4 opened, permits the assembly to be placed in a smaller injection  
5 molding machine than would otherwise be required to produce the  
6 same number of parts in each cycle from a machine using a rotary  
7 machine plate or an indexing plate.

8 Even though the rotating center plate mold described above is  
9 an improvement over conventional two-shot molding machines, it  
10 still is impractical for use on elongated objects, such as  
11 toothbrushes and the like, for the reasons mentioned above in  
12 conjunction with the discussion about such products.

13 Therefore, it is desirable to provide a two-component  
14 injection mold for manufacturing two-component elongated products,  
15 which may be used with relatively small injection molding machines,  
16 and which employs a floating rotatable center plate mounted in a  
17 frame between a pair of reciprocating mold plates in which the  
18 rotatable mold plate is used to form only a portion of an elongated  
19 product to be produced by the mold.

20  
21 SUMMARY OF THE INVENTION

22 It is an object of this invention to provide an improved two-  
23 component injection mold.

24 It is another object of this invention to provide an improved  
25 two-component injection mold using a rotating center plate.

26 It is an additional object of this invention to provide an

1 improved two-component injection mold using a rotating center plate  
2 carried by a floating frame.

3 It is a further object of this invention to provide an  
4 improved two-component injection mold utilizing three mold plates,  
5 the central one of which rotates on an axis perpendicular to the  
6 opening and closing direction of movement of the mold plates;  
7 wherein the rotating mold plate is mounted in an open frame to  
8 permit passage of portions of the other mold plates on either side  
9 of the rotating plate.

10 In accordance with a preferred embodiment of this invention,  
11 an injection mold for manufacturing two-component elongated members  
12 includes first and second mold cavity members mounted for relative  
13 movement toward and away from one another in each cycle of  
14 operation, to close and open the mold, respectively. A central  
15 frame member, designed to overlies at least a portion of each of the  
16 first and second mold cavity members when the mold is closed,  
17 carries a rotatable mold plate located between a portion of each of  
18 the first and second mold cavity members for engagement thereby  
19 when the mold is closed. The rotatable mold plate is designed to  
20 rotate 180° for each closing and opening cycle of the first and  
21 second mold cavity members.

22  
23 BRIEF DESCRIPTION OF THE DRAWINGS

24 Figure 1 is a perspective view of an injection molding machine  
25 diagrammatically illustrating the location of a preferred  
26

embodiment of the invention therein;

Figure 2 is a diagrammatic perspective representation of the preferred embodiment of the invention;

Figures 3A, 3B and 3C are diagrammatic representations of a cycle of operation of the preferred embodiment of the invention;

Figure 4 is a detailed front view of a portion of the preferred embodiment of the invention;

Figure 5 is a partial bottom view of a portion of the embodiment shown in Figure 4;

Figure 6 is a top closed view of the preferred embodiment of the invention;

Figure 7 is a bottom detailed view of a portion of the embodiment shown in Figures 4 and 6;

Figure 8 is a bottom detailed view of another portion of the embodiment of the invention shown in Figures 4, 5 and 6;

Figure 9 is a detail of the central portion of the embodiment shown in Figures 6 and 10; and

Figure 10 is a top view of the preferred embodiment of the invention showing the mold in its open position.

#### DETAILED DESCRIPTION

Reference now should be made to the drawings, in which the same reference numbers are used throughout the different figures to designate the same components. Figure 1 shows a typical injection molding machine 10, with which the embodiment of this invention may be used. The injection molding machine 10 may be of any standard

1 suitable configuration used for two-component molding of products.  
2 Such a machine typically includes a control panel 12 for  
3 controlling its operation. In addition, plastic material for  
4 injection into the mold cavities and the mold plates is supplied  
5 through a pair of injection rams (one for each of the two different  
6 components to be molded), one of which 14 is illustrated in Figure  
7 1.

8 ~~In Figures 1, 2 and 3, the details of the standard mold~~  
9 ~~blocks, including the manifolds, plastic delivery system, cooling~~  
10 ~~lines and the like, have been removed to show a diagrammatic~~  
11 ~~arrangement of the mold plates or mold cavity plates used in a~~  
12 ~~preferred embodiment of the invention for molding toothbrush~~  
13 ~~bodies. To accomplish this, a fixed mold block 18, carrying mold~~  
14 ~~plates 18 and 18B for two separate manifold systems is provided.~~  
15 ~~The mold plate 18A is injected with the first material for a~~  
16 ~~toothbrush pre-form, whereas the second plate 18B includes a~~  
17 ~~manifold for injection molding the second material to form a two-~~  
18 ~~component toothbrush handle. Figures 4 and 10 illustrate these~~  
19 ~~different plate portions 18A and 18B most clearly; although they~~  
20 ~~are diagrammatically indicated in Figure 3B also.~~

21 In conjunction with the fixed mold block 18, there is a  
22 movable mold block 16, again mounted on conventional apparatus in  
23 an injection molding machine for movement toward and away from the  
24 mold block 18 to close and open the mold, respectively. The mold  
25 which is illustrated is a straight pull mold, which slides on four  
26 pairs of guide pins located, respectively, at the two lower corners

1 and two upper corners of the mold assembly. Only one pair of these  
2 guide pins, 50 and 52, is illustrated in Figures 7 and 10 for  
3 purposes of clarity, since each pair is identical to the pair 50/52  
4 which is illustrated. As is most apparent from Figure 4, the guide  
5 pins extend through two pairs of lower guide pin holes 34 and two  
6 pairs of upper guide pin holes 36 formed through the various  
7 components of the mold blocks 16, 18 and a movable frame 30 for a  
8 central mold plate.

9 Before entering into a description of the detailed mechanism  
10 shown in Figures 4 through 10, a brief description of the overall  
11 operation of the preferred embodiment of the invention is  
12 considered in order. This description is made in conjunction with  
13 Figures 2, 3A, 3B and 3C, which diagrammatically illustrate the  
14 basic operating characteristics and general functional features of  
15 the preferred embodiment of the invention shown in detail in  
16 Figures 4 through 10. As shown in Figures 2 and 3, the mold for  
17 making toothbrush handles or other elongated bodies, includes a  
18 first mold block 18 having two sides or plates 18A and 18B (Figure  
19 3B). Opposing the mold block 18 is a movable mold block 16, which  
20 is designed to move horizontally in the mold machine of Figure 1 in  
21 the direction of the double arrows, shown in Figure 2 and the  
22 arrows shown in Figures 3A and 3C, to open and close the mold  
23 cavities formed between the plates 16A and 16B, which correspond  
24 and mate with the plates 18A and 18B, respectively. This is most  
25 apparent from an examination of Figures 3A to 3C.

26 In between the mold blocks 18 and 16 is a movable frame 30

(not shown in Figures 2 and 3), which carries a rotatable plate 20 designed for rotation about a vertical axis 24, as illustrated in Figures 2 and 3B. As is apparent from both Figures 2 and 3, the rotatable mold plate 20 has two offset sections "A" and "B", which are designed to fit into corresponding recesses 19 and 17 on the mold blocks 18 and 16, respectively. The portions A and B are identical in external configuration; so that either of them fits into either of the recesses 17 and 19, as most clearly shown in Figures 3A and 3C.

In the operation of the mold machine carrying the mold blocks 16, 18 and the frame 30 in which the rotatable plate 20 is mounted, the cycle originally commences with the mold closed and the segment A of the rotatable central plate nested into the recess 19 of the mold block 18 and the segment B of the rotatable central plate nested into the recess 17 of the mold block 16. The mold plate 18 extends beyond the segment 20A (in Figure 3A) to abut directly against the corresponding mating portions of the mold plate 16A, in the manner of a standard two-plate straight pull mold. Similarly, portions of the mold plate 16B extend beyond the edge of the rotatable center plate 20B to engage the mating front of the mold plate 18B. This closed configuration is not shown in Figure 3A, which illustrates the position of the various components just after the mold commences opening from the closed position described.

When the mold is first closed, the first component plastic material is injected into the first component mating cavities in the mold plates 16A and 18A and in mating cavities in the mold



1 plates 16A and 20A (as illustrated in detail in Figure 4 for the  
2 surfaces 18A and 20A). This injection of the first component  
3 material forms the pre-form 26 of the toothbrush handle and head.  
4 The mold then is opened, as illustrated in the initial stages in  
5 Figure 3A. As the block 16 moves away from the fixed position  
6 block 18, the central floating frame 30 moves at half the rate to  
7 half the distance, to place the rotatable center plate 20A/B at a  
8 position midway between the two mold blocks 16 and 18 when the mold  
9 is fully opened. This is diagrammatically illustrated in Figure  
10 3B, and as illustrated in detail in Figure 10.

11 Either upon fully reaching the position shown in Figures 3B  
12 and 10, or as the various components move from the closed position  
13 to the open position, the central rotatable plate 20 is rotated  
14 180° in the direction of the arrows shown in Figures 3B and 10 to  
15 reverse the positions of the rotatable plate portions A and B, as  
16 shown in Figures 3A and 3B. At this time, the pre-form 26 is  
17 rotated to the position on the right; and (in all but the first  
18 cycle of operation), the finished two-component toothbrush handle  
19 28 is rotated to the left-hand side of the mold, from the right, as  
20 illustrated in Figure 3B. As indicated by the arrow attached to  
21 the toothbrush handle 28 in Figure 3B, suitable mechanism is used  
22 to eject the finished toothbrush handle from this open mold  
23 position to prepare the mold for the next cycle of operation.

24 Consequently, when the mold once again closes as shown in  
25 Figure 3C, a new pre-form 26 is formed on the left-hand side, while  
26 simultaneously, the second shot of plastic is applied through a

1 manifold on the plate 18B to complete the molding of the second  
2 component around the pre-form handle 26. The mold then opens; and  
3 the cycle described above is repeated, with the simultaneous  
4 formation of pre-forms on the left-hand side of the mold plates  
5 shown in Figures 3A through 3C and formation of the finished  
6 product on the right-hand side of the mold plates, as shown in  
7 Figures 3A through 3C. In each cycle of operation, the central  
8 rotating plate 20 A/B rotates 180°; and upon completion of the  
9 rotation, the finished parts 28 are ejected prior to reclosure of  
10 the mold as shown in Figure 3C.

11 It is important to note, even from the diagrammatic  
12 representation shown in 3B, that only the head portion (of a  
13 toothbrush handle) or a small percentage of the total length of the  
14 toothbrush handle body remains in a cavity in the rotatable plate  
15 20. In actuality, only the portion of the toothbrush handle which  
16 subsequently has bristles inserted into it is the portion which is  
17 carried in the mold sections A and B of the rotatable central mold  
18 plate 20. The rest of the pre-form, as well as the finished  
19 handle, other than the head or bristle portion, extends beyond the  
20 central rotating plate 20A/B more than four to six inches across.  
21 The toothbrush handles extending substantially 180° outwardly from  
22 both sides of the plate 20 A/B may have an overall length of 14 or  
23 15 inches. Thus, a relatively small mass for the rotatable plate  
24 20 is required, compared to what would be required if the entire  
25 pre-form (and, therefore, finished product) needed to be carried in  
26 a cavity on the rotatable plate 20.

1 To accomplish the operation which has been outlined above in  
2 conjunction with the diagrammatic drawings of Figures 2 and 3, the  
3 mold shown in detail in Figures 4 through 10 has been designed. An  
4 important component of this mold is the mounting of the rotatable  
5 plate 20 in an open rectangular frame 30 (shown most clearly in the  
6 end view of Figure 4). The plate 20 is pivotally mounted by means  
7 of a central pivot mechanism 24 extending from the top to the  
8 bottom of the opening 32 in the frame 30. The distance between the  
9 edges of the offset portions A and B of the rotatable plate 20 and  
10 the vertical edges or sides of the opening 32 in the frame 30 is  
11 selected to be great enough to permit the toothbrush handle  
12 extensions for the pre-form 26 and for the finished handles 28 to  
13 rotate within the frame 30.

14 The cavities in the mold plates 18A and 18B for the lowermost  
15 25% of the plates 18A and 18B are shown through the open frame in  
16 Figure 4 (as would be viewed from the movable mold block 16). The  
17 upper segments of the plates 18A and 18B are identical to the  
18 lowermost segment, but the details are not shown to avoid  
19 cluttering of the drawing.

20 It also can be seen from an examination of the cavities shown  
21 in the plate surface 20A and 18A, that the pre-form for the entire  
22 toothbrush, including the portion in which bristles are  
23 subsequently to be formed (in plate 20 of Figure 4), forms a  
24 continuous cavity with respect to the mold plate surface 16A. The  
25 reverse side of the plate 20, showing the position where the second  
26 material is molded onto the pre-form, has no corresponding mold

1 surface for the back or reverse side of the central mold plate  
2 portion 20B.

3 The offset mold plates 20A and 20B are identical. This is  
4 apparent from a consideration of Figures 2 and 3A, and the  
5 description provided previously.

6 The rotation of the central mold plate 20 on the shaft 24 may  
7 be controlled by means of an electrical servo-motor, hydraulics, or  
8 mechanical apparatus of any suitable type. Such mechanisms are  
9 well known, and for that reason, have not been shown in the  
10 drawings.

11 As mentioned previously, the sliding mold plate 16 and the  
12 central floating frame 30 are moved on pairs of guide pins, such as  
13 the guide pins 50 and 52, extending through the guide pin hole sets  
14 34 and 36, shown most clearly in Figure 4. Figure 7 shows the  
15 location of the set of guide pins 50 and 52 when the mold is in its  
16 closed position; and Figure 10 shows the position of those same  
17 guide pins with the mold in its open position.

18 Reference now should be made to Figure 6, which shows the mold  
19 in its closed position. In this position, the pre-form 26 for a  
20 toothbrush handle is formed in the left-hand side of the closed  
21 mold; and the second component injection for the finished handle 28  
22 is simultaneously formed on the right-hand side of the closed mold.

23 Portions of the top of the frame 30 and of the mold plates 16  
24 and 18 have been removed to show the parting lines between the  
25 various components of the mold in its closed injection molding  
26 position. The vertical sides of the frame 30 are shown at each end

1 of the apparatus of Figure 6, where it can be seen that the mold  
2 plate surfaces 16A, 18A, 18B and 16B extend through the frame  
3 opening 32 beyond the rotatable plate 20A/20B to engage mating  
4 cavity sections on one another. Part of the plate 18A also engages  
5 the front surface of the facing mold plate 20A in the rotatable  
6 mold plate 20. The corresponding face of the face of the mold  
7 plate 16B engages the pre-form carried on the mold plate 20B (as  
8 illustrated in Figure 6). Obviously for the next subsequent cycle  
9 of operation, the positions of the mold plates 20A and 20B will be  
10 180° reversed. The plates 20A and 20B are identical, and the  
11 operation is identical for each cycle of operation.

12 By utilizing the open floating frame 30 in the manner  
13 described, a much simpler, smaller and less complex rotatable mold  
14 is possible than would be the case if the entire pre-form and the  
15 entire finished product had to be carried in cavities on the  
16 central rotating portion. As is readily apparent, especially in  
17 Figures 9 and 10, the toothbrush handle, both on the pre-form and  
18 on the finished product, extends well beyond the bristle portion,  
19 which is the only part carried on the faces 20A and 20B of the  
20 central rotatable plate 20.

21 When the mold is in the position shown in Figure 6, injection  
22 of the pre-form plastic is supplied through runners 60 of the plate  
23 18A to form the pre-form 26 in cavities in the face of the movable  
24 mold plate 16A and the face of the rotatable mold plate 20A.  
25 Simultaneously, the second plastic component (which may be a  
26 different material, or a material of a different color) is injected

1 through runners similar to the runners 16 of the plate 18B to form  
2 the finished two-component handle 28. Again, for purposes of  
3 clarity, these runners for injecting the second plastic component  
4 are not shown in the drawing, since the manner in which this is  
5 done is conventional. It also should be noted that the various  
6 cooling channels and the apparatus for supplying cooling fluid  
7 through the channels is not described, since the techniques for  
8 doing this are conventional and do not form a part of this  
9 invention.

10 After formation of the pre-form 26 on the left-hand side as  
11 shown in Figure 6, and of the finished two-component handle 28 on  
12 the right-hand side of Figure 6, the mold is opened to the position  
13 shown in Figure 10. Different techniques can be used to ensure  
14 that the central floating plate or frame 30 is located exactly in  
15 the center between the plates 16 and 18. A technique, however,  
16 which is considered quite effective is to use a pair of racks 40  
17 and 42 attached to the plates 16 and 18, as shown most clearly in  
18 Figure 8, to operate on a gear set 50 placed in a housing 39 on the  
19 bottom of the frame 30, as shown in Figures 4, 5, 8 and 10. These  
20 racks 40 and 42 rotate a freely pivoted gear 50 mounted on the  
21 frame 30 such that for each inch of movement of the plate 16 toward  
22 and away from the plate 18, the frame 30 moves in the corresponding  
23 direction one-half inch. This type of mechanism is well known, and  
24 is suitable for the operation of the mold system of a preferred  
25 embodiment of this invention.

26 Ideally, although only one rack and gear set 40, 42, 50 has

1 been illustrated in detail in the drawings, four such rack and gear  
2 sets are provided to ensure accurate positioning. The four sets  
3 are located at the lower corners and the upper corners of the frame  
4 30 and are illustrated in Figure 4, and two of them are illustrated  
5 in Figure 5. The rack sets include the set 40/42 just described  
6 and a mating set 44/46 located in a housing 49 on the opposite side  
7 of the bottom of the center frame member 30. Corresponding sets on  
8 the upper ends (or corners, as viewed in Figure 4) of the floating  
9 frame 30 include racks 41, 43, and 45, 47. All of these racks  
10 operate on gears similar to the gear 50 attached for free rotation  
11 on the frame 30. By utilizing four sets of identical racks,  
12 twisting or rocking of the frame 30 during the cycle of operation  
13 of the machine is reduced to a minimum.

14 Reference now should be made to the enlarged view of Figure 9,  
15 which shows the central rotating plate 20 with the two sections 20A  
16 and 20B illustrated. When the plate rotates, at the end of a full  
17 two-step operating cycle, to present the finished two-component  
18 toothbrush handle 28 to the position shown on the left-hand side in  
19 Figure 9, a piston 62 is operated to move downwardly (as viewed in  
20 Figure 9) to withdraw a plurality of pins 60 (only one of which is  
21 shown, to avoid cluttering the drawing) from the bristle holes in  
22 the head of the toothbrush handle 28. The pins 60 hold the pre-  
23 form 26 in place as the central rotatable plate 20 is rotated 180°  
24 in the operation of the machine as described previously.  
25 Withdrawal of the pins from the handle 28 by the piston 62 effects  
26 release of the handle 28, which then drops from the machine as

1 diagrammatically indicated in Figure 1. The handles 28 then are  
2 supplied either to a bin, such as the bin 22 of Figure 1, or to a  
3 conveyor for subsequent operation by a bristle inserting machine.  
4 Because a relatively large number of pins 60 extend into the pre-  
5 form 26 (and also into the finished two-component handle 28), the  
6 pre-form 26 is held firmly in place during rotation of the central  
7 rotating plate 20; so that alignment of the plastic pre-form 26  
8 with corresponding cavities in the faces 18B and 16B of the  
9 reciprocating mold plates is ensured for the second shot, as  
10 described.

11 The foregoing description of the preferred embodiment of the  
12 invention is to be considered as illustrative and not as limiting.  
13 Various changes and modifications may be made to perform  
14 substantially the same function, in substantially the same way, to  
15 achieve substantially the same result by those skilled in the art,  
16 without departing from the true scope of the invention as defined  
17 in the appended claims.  
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